A2 LEVEL CHEMISTRY

4.1.2 CARBONYL COMPOUNDS
4.1.3 CARBOXYLIC ACIDS AND ESTERS

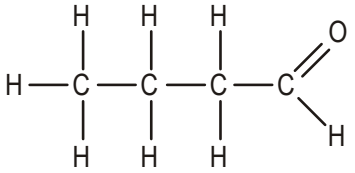
TEST

Answer all questions

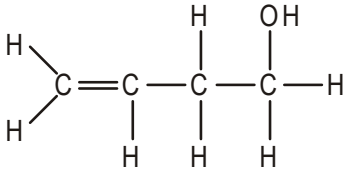
Max 47 marks

Name	……..
Mark	……../47 ……....% Grade ……

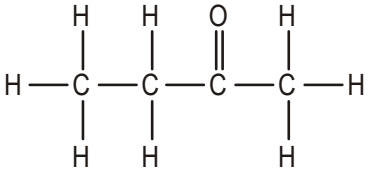
1. An unknown colourless liquid with molecular formula C_4H_8O was thought to be one of butanal, but-3-en-1-ol, or butanone.



butanal



but-3-en-1-ol



butanone

(a) State a simple chemical test that would positively identify:

(i) butanal **only**;

reagent .....

observation .....

organic product .....

[3]

(ii) but-3-en-1-ol **only**.

reagent .....

observation .....

type of reaction .....

[3]

(b) Butanal and butanone both react with 2,4-dinitrophenylhydrazine to produce mixtures containing orange precipitates.

Outline how the mixtures containing these orange precipitates can be used to distinguish between butanal and butanone.

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[3]

[Total 9 marks]

2. An ester **D** with the formula, $CH_3CH_2COOCH_2CH(CH_3)_2$, is used in rum flavouring.

(a) Draw a displayed formula of ester **D**.

[2]

(b) Outline how you could obtain a sample of ester **D**, starting with a named carboxylic acid and a named alcohol.

Include any essential reaction conditions and write an equation for the reaction. You do not need to include any details of the separation or purification of the ester.

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[6]

(c) State a spectroscopic method that could be used to confirm that a sample of ester **D** has a molecular mass of 130.

Explain how you would obtain the molecular mass of **D** from the spectrum.

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[2]

[Total 10 marks]

3. Benzoic acid and phenylmethanol will react with each other in the presence of a suitable catalyst.

(i) State a suitable catalyst for this reaction.

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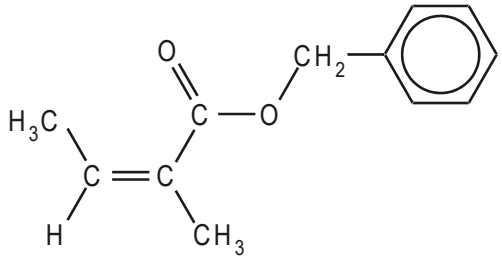
[1]

(ii) Draw the displayed formula of the organic product.

[2]

[Total 3 marks]

4. Compound **A** is used to add the flavour of mushrooms to foods.



compound **A**

(a) (i) Apart from the benzene ring, name the two functional groups in compound **A**.

....

[2]

(ii) Draw the skeletal formula of compound **A**.

[1]

(iii) Deduce the molecular formula of compound **A**.

.....

[1]

(b) Compound **B** is a stereoisomer of compound **A**.

Explain what is meant by the term *stereoisomerism*. Use compounds **A** and **B** to illustrate your answer.

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[2]

(c) If the food is cooked for a long time, naturally occurring acids catalyse the hydrolysis of compound **A**.

Draw structures to show the **two** organic compounds formed by the acid hydrolysis of compound **A**.

[2]

(d) The hydrolysis of compound **A** can be monitored by sampling the mixture at regular intervals, separating the components, and recording their infra-red spectra.

(i) State **two** absorptions that would be expected in the infra-red spectrum of compound **A**, and identify the parts of the molecule responsible for each.

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[2]

(ii) Suggest a wavenumber range within the spectrum that could be used to clearly distinguish compound **A** from the products formed by the hydrolysis reaction.

Explain your answer.

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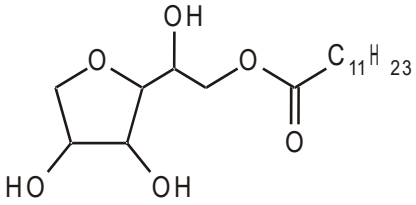
[2]

[Total 12 marks]

5. The demand for 'natural' shampoos and detergents has led to the development of more biodegradable detergents such as sorbitan monolaurate, which is made from plants.



sorbitan monolaurate

(i) Suggest a type of reaction that could break down sorbitan monolaurate when it is washed into drains and rivers.

Explain your answer and state the type of organic products formed.

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[3]

(ii) Suggest **one other** reason why detergents such as sorbitan monolaurate are regarded as 'environmentally friendly'.

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[1]

[Total 4 marks]

6. Explain why triglycerides are soluble in non-polar solvents and not in water.

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[Total 3 marks]

7. Linoleic acid, $C_{17}H_{31}COOH$, is an unsaturated fatty acid found in triglycerides from sunflower oil.

(i) Draw the structure of the triglyceride made from linoleic acid, $C_{17}H_{31}COOH$, and propane-1,2,3-triol. Show clearly all the bonds in the ester groups.

[2]

(ii) Deduce the number of carbon to carbon double bonds in a molecule of the triglyceride.

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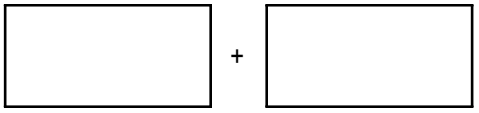
[1]

[Total 3 marks]

8. Complete the reactions by drawing structural formulae in each of the boxes provided.

(i) CH_3CHO $\xrightarrow[(\text{ammoniacal } AgNO_3) \text{ / heat}]{\text{Tollens' reagent}}$ 

[1]

(ii) $H_3CCOOCH_2CH_3$ $\xrightarrow[\text{heat}]{HCl(aq)}$ 

[2]

[Total 3 marks]